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Extending the Concept of Control Beliefs: Integrating the Role of Advice Networks

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Abstract. Although control beliefs (CBs) can represent many different types of controls, information systems researchers have focused primarily on CBs related to technical compatibility, resource availability, and computer self-efficacy. More recent research has recognized that co-worker advice, which represents situated and improvised learning, can also be an important factor that can enable or impede system use. In addition, because advice from co-workers represents the social context by which the impacts of other traditional CBs are embedded, they may have the potential to alter the relationships between traditional CBs and system use. Against this backdrop, we examined the direct effects of CBs about advice from co-workers on system use as well as its ability to moderate the effects of other types of CBs on system use. To accomplish this, we conducted a three-month study of 112 employees in one business unit of an organization. Results supported our hypotheses that CBs about advice from co-workers directly influence system use and moderate the effects of other CBs on system use.

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Introduction

Prior research has typically captured the effect of behavioral control on system use through control beliefs (CBs), sometimes labeled facilitating conditions (FC), a key predictor of system use (Taylor and Todd 1995, Thompson et al. 1991, Venkatesh et al. 2003). CBs refer to the perceived presence of specific factors that enable or impede the performance of a behavior (Ajzen 1985). Although Ajzen (1985, 2005) discussed many different types of possible CBs representing various types of controls, information systems (IS) researchers have focused primarily on CBs related to technical compatibility, resource availability, and computer self-efficacy (CSE) (Venkatesh et al. 2012). Recent research, however, has recognized that co-workers can also be an important factor that can enable or impede system use (e.g., Boudreau and Robey 2005, Bruque et al. 2008, Sykes et al. 2009, Venkatesh et al. 2011) and has highlighted the importance of situated and improvised learning on system use (Boudreau and Robey 2005). Yet, to our knowledge, the role of co-workers has not been specifically theorized as a type of CB and has not been examined vis-à-vis other CBs in explaining system use. Given that some of this research has taken a social network perspective and has shown that constructs derived from a user's social network have been valuable in explaining system use (Bruque et al. 2008, Sykes et al. 2009), we take a social network perspective to argue that advice from co-workers is a type of CB that represents situated learning that occurs through improvised adaptation to a new system by end users and can facilitate or inhibit system use.

We suggest that advice from co-workers differs from CBs examined in prior research, i.e., technical compatibility, resource availability, and computer self-efficacy, in several ways. For example, unlike beliefs about one's ability (i.e., self-efficacy), advice from co-workers is not completely individually driven but rather relies on social interactions. Furthermore, unlike CBs related to technical compatibility and resource availability, which are normally available to all users in a given department or organization, advice from co-workers is derived through informal social interactions based on each employee's interaction with co-workers. Past research on social networks has shown that resources available through these individual interactions differ significantly across individuals even in the same department and may constrain or enable individual behavior (Ahuja et al. 2003, Brass 1984, Ibarra 1993, Krackhardt and Porter 1986, Robert et al. 2008, Sparrowe and Liden 1997, Sykes et al. 2009). In addition, advice from co-workers can alter the relationships between traditional CBs and system use. For example, co-workers could be an important source of information about how to overcome technical incompatibility with a new system or how to use the resources provided by an organization. This would imply that the effect of technical compatibility and resource availability on use can be influenced by access to advice from co-workers. Both Ajzen (1991) and Triandis (1979) proposed that CBs could have direct as well as moderating effects by creating conditions for individuals that make it easier or more difficult for them to engage in a behavior. Despite these suggestions, the possibility that CBs might moderate the effects of other CBs has not, to our knowledge, been examined in IS research. This paper advances a model of system use with the goal of answering the following research question: What impact does advice from co-workers have on system use and on the relationship between traditional types of CBs and system use? To answer this and contribute to research on system use, we pursue the following objectives:

(i) extend the concept of CBs to include advice from co-workers;

(ii) develop and test a model to explain how each type of CB will influence two conceptualizations of system use, i.e., duration of use and deep structure use, separately and jointly.

Background

Control Beliefs

CBs originate from the theory of planned behavior (TPB; Ajzen 1985). In the TPB, behavior is a function of an individual's behavioral intention (BI) to perform the behavior and his control over the behavior. BI represents an individual's motivation to engage in the behavior. Behavioral control denotes the degree to which an individual has the ability, resources, and opportunities to perform the behavior. Behavioral control can be represented by an actual objective control factor or an individual's perception of their control over the behavior (Ajzen 1991, 2002). Whereas perceived behavioral control (PBC) represents the overall perceived control over behavior, CBs are the perceived presence of specific factors that enable or impede the performance of a behavior and that together combine to form PBC (Ajzen 1991, 2002). There are two types of CBs, i.e., internal and external (Ajzen 2002). Internal CBs are about whether one believes they have the innate ability to perform the behavior (Bandura 1986). External CBs are about whether an individual has the resources and opportunities needed to perform the behavior (Ajzen 2002). CBs have often been mislabeled as facilitating conditions (FC) in the IS literature. Despite the similarities between CBs and FC, there are clear distinctions between the two constructs. The term "facilitating conditions" originates from the theory of interpersonal behavior (TIB) (Triandis 1971, 1979). FC represent *external objective* factors in the environment that make an act easier or more difficult to perform, whereas CBs are *perceptions* that can represent *internal* and *external* control (Ajzen 2002, Triandis 1971) and may or may not reflect actual obstacles and facilitators.

Control Beliefs in the IS Literature

To assess how the IS literature has conceptualized and operationalized CBs, we reviewed the IS literature on the concept of behavioral control. We reviewed articles spanning a period of over 10 years, i.e., 2003 to 2012, in four leading IS journals: *Information Systems Research, MIS Quarterly, Journal of Management Information Systems,* and *Journal of AIS.* Online Appendix 1 provides a list of 13 papers. Several trends emerged across the papers we reviewed. First, all attempts to capture the effects of behavioral control were done through perceptual, rather than objective, measures. Although IS researchers have operationalized behavioral controls as perceptions, consistent with CBs but not FC (for an example, see Thompson et al. 1991), they have often labeled these perceptions of control as FC rather than CBs (e.g., Taylor and Todd 1995, Venkatesh et al. 2003). Second, to our knowledge, IS researchers have always modeled the effects of CBs or FC as a direct influence on PBC, BI or system use, rather than as a moderator. Despite the fact that TPB and TIB posit that behavioral controls can also moderate the relationship between BI and use (especially when these reflect actual control), no study that we reviewed attempted to empirically test these potential moderating effects. Third, although Ajzen (1985, 2005) discussed many types of possible actual behavioral controls and corresponding CBs, to our knowledge, IS researchers have focused on only three: (a) technology facilitating conditions (TFC) that represent beliefs about technical compatibility between the new and existing systems; (b) resource facilitating conditions (RFC) that represent beliefs about the training and technical support provided by the organization to support the use of the new system; and (c) CSE that represents belief about an individual's ability to use computer systems. Finally, all of the studies examining system use relied on a lean conceptualization of system use (i.e., duration, frequency, and intensity of use) as their dependent variable. Lean conceptualizations of use are based on use alone, whereas richer conceptualizations, which have been shown to be better predictors of performance, reflect the nature of use by including the system, user, and task (Burton-Jones and Straub 2006).

Situated and Improvised Learning: Co-Worker Advice and Social Networks

Situated learning is a social process whereby knowledge is co-constructed by individuals and which is context specific to the environment in which these individuals are embedded (Boudreau and Robey 2005, Lave 1991). Lave and her colleagues were among the first to recognize that learning continues after formal training through communities of practice in the workplace, i.e., a group who share a common profession or practice (Lave 1991, Lave and Wenger 1991). These communities of practice often produced learning through "knowledge and action" by "changing understanding in practice" (Lave 2009, p. 202). It has long been recognized in the IS literature that a significant amount of learning occurs after formal training ends and actual use begins (Bergeron et al. 1990, Gallivan et al. 2005, Snoddy and Novick 2004). For example, Boudreau and Robey (2005) demonstrated that users often form a community of practice to facilitate situated and improvised learning to help users understand how to use new systems. Specifically, they found that a subset of users often improvised and discovered better ways to use the new system compared to what they learned through formal training and assistance.

Social network theory is one way to examine the effects of situated and improvised learning because it captures the social interactions between employees. Several studies have examined the direct impact of social interactions between co-workers on system use. Bruque et al. (2008) found that the number and strength of social interactions between co-workers facilitated system use. Similarly, Sykes et al. (2009) found that the number and intensity of interactions between co-workers facilitated system use. Venkatesh et al. (2011) studied the impact of social interactions in and across three groups, i.e., doctors, paraprofessionals, and administrative personnel, and found that social interactions in and between paraprofessionals and administrative personnel increased system use. Taken together, these studies provide evidence that social interactions between co-workers can affect system use.

We study the effects of situated and improvised learning, conceptualized as advice from co-workers, on system use. These social interactions between co-workers are how employees exchange information, assistance, and guidance related to using the system to perform one's work (Bruque et al. 2008, Sykes et al. 2009). Advice from co-workers on how to use the system can be viewed as a type of, and product of, situated learning (Boudreau and Robey 2005). As mentioned earlier, CBs are "beliefs about the presence of factors that may further or hinder performance of the behavior" (Ajzen 2002, p. 665). The availability of information needed to perform a behavior or the occurrences of unforeseen disruptive events are both examples of control factors (see Ajzen 2005). Advice from co-workers can reflect the availability of information needed to use the system and the ability of users to overcome unforeseen disruptive events during use of the system. We thus conceptualize that advice from co-workers is also a type of CB. Therefore, we present advice from co-workers as a new type of CB, which we call CB related to advice from co-workers (CB-AC).

System Use

We draw on the work of Burton-Jones and Straub (2006) and use two key conceptualizations and associated measures of system use, i.e., duration of use and deep structure use. Duration of use, commonly measured using log-in time, is one of the most well studied conceptualizations and measures of system use (Venkatesh et al. 2008). Deep structure use is a post-acceptance behavior that involves the integration of the system with the user's tasks (Wang and Butler 2006). Deep structure use represents the degree to which a system is used for everyday activities and the extent to which a user is fully leveraging the capabilities of the system (Wang and Butler 2006).

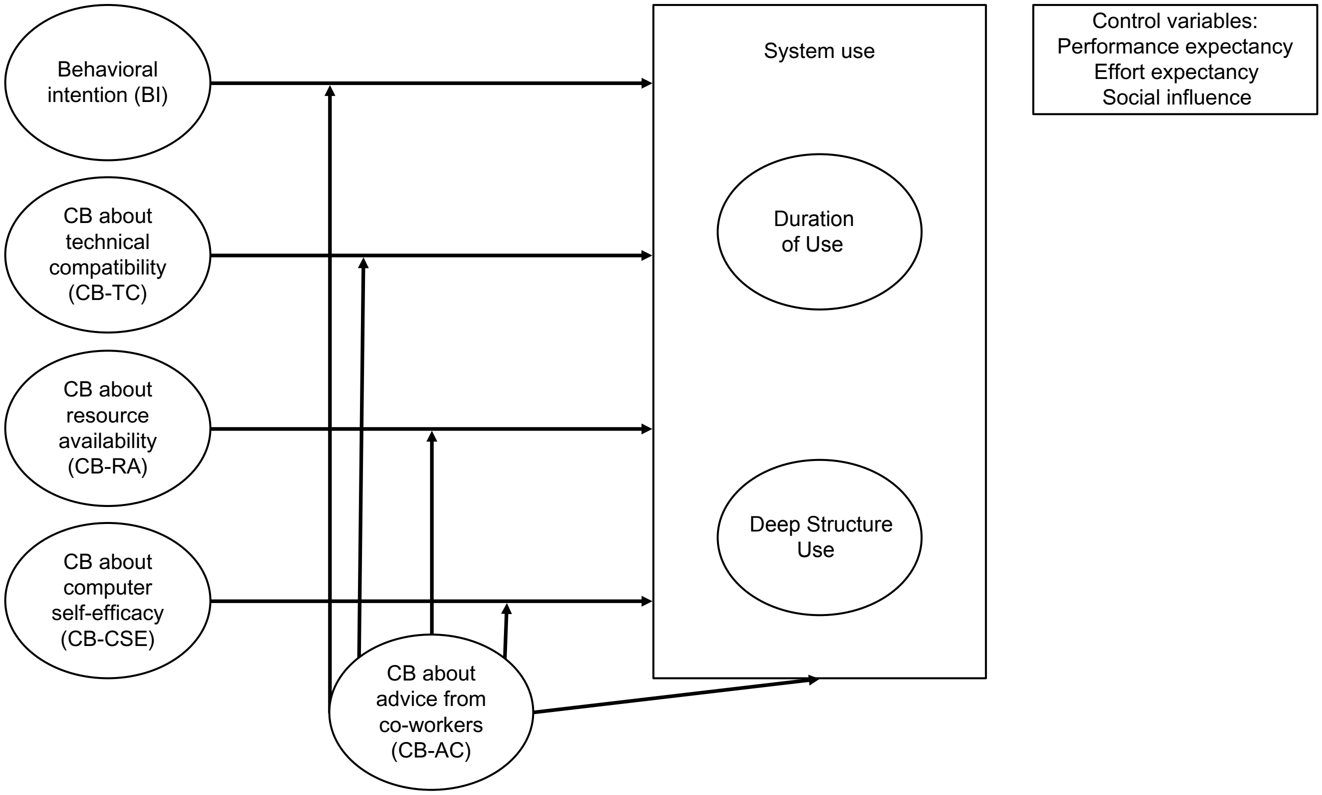
Model Development

Figure 1 shows our research model. First we present the main effects of BI and CBs on the two conceptualizations of system use. Because the relationships between BI and CBs with system use are well established, we cover them briefly for the sake of completeness. Second, we present the main effects related to CB-AC. We then introduce hypotheses related to the moderating effects of CB-AC on the relationship between each CB and each conceptualization of system use. Finally, grounded in the long-standing suggestions of Ajzen (2002) and Triandis (1979), we briefly discuss, without specific hypotheses, the possibility of moderation effects of CB-AC on the relationship between BI and each conceptualization of system use.

Behavioral Intention and System Use

BI has been examined as a predictor of system use in several studies (see Venkatesh et al. 2003). BI reflects an individual's conscious plans to engage or not engage in a particular behavior (Warshaw and Davis 1985) and represents the motivational drive directed at performing a specific behavior (Venkatesh et al. 2008). When an individual expresses a strong degree of intention to engage in a behavior, they are much more likely to perform that behavior and for longer periods of time (Ajzen 1991). This explains why BI has been a consistent predictor of duration of use (Venkatesh and Davis 2000, Venkatesh et al. 2003). Similarly, an individual who is motivated to use the system is also

Figure 1. Research Model



more likely to try more of the system's features. Thus, we hypothesize:

Hypothesis 1 (H1). *BI will positively influence* (a) *duration of system use and* (b) *deep structure use.*

Before we present the rest of our model, we highlight a few points related to our use of various terms where we depart from prior IS literature. First, consistent with Ajzen (2002), we use the term CBs to represent the perceptual counterparts of actual behavioral controls, and not FC since these are not objective behavioral control factors. Therefore, we avoid the term "facilitating conditions" and rename TFC and RFC as CBs about technical compatibility (CB-TC) and CBs about resource availability (CB-RA), respectively. However, their conceptual definitions remain the same (Mathieson et al. 2001, Taylor and Todd 1995, Venkatesh 2000). Similarly, we relabeled CSE as CBs about one's CSE (CB-CSE). Second, and consistent with the IS literature, we believe it is important to examine the impacts of CBs separately to understand what specific causes drive system use, rather than as an overall aggregate construct (i.e., PBC). We believe this will become increasingly important as both new types of CBs and new types of system use are identified.

Control Belief About Technical Compatibility and System Use

Technical compatibility represents the degree to which the new system can integrate with existing systems (Venkatesh 2000). The more ways the new system allows employees to seamlessly integrate with existing systems, the more tasks they will be able to perform with the current system (Taylor and Todd 1995). Therefore, we expect technical compatibility to be associated with increases in duration of use. We also expect that, all else being equal, technical compatibility will increase the range of features users can deploy to leverage integration with other existing systems. Thus, we hypothesize:

Hypothesis 2 (H2). *CB-TC will have a positive effect on* (a) *duration of use and* (b) *deep structure use.*

Control Belief About Resource Availability and System Use

Resource availability should be positively related to both types of use. The resources made available include formal training, help desk services, and online reference materials provided to users (Taylor and Todd 1995). All these resources are designed to help the user use the system by removing potential barriers to use. Prior research has consistently shown that as barriers to use decrease, users use the system for longer periods of time (Davis et al. 2009, Gallivan et al. 2005, Mathieson et al. 2001). This logic is often used to explain why resource availability has been a strong predictor of duration of use (Venkatesh et al. 2003). A similar logic applies to deep structure use. Training programs and online reference materials are designed to introduce users to features needed to perform their job (Santhanam et al. 2007). The more resources provided, the more opportunity users have for exposure to more features. Therefore, deep structure use should increase along with the resources made available to help users use new systems. Thus, we hypothesize:

Hypothesis 3 (H3). *CB-RA will have a positive effect on* (a) *duration of use and* (b) *deep structure use.*

Control Belief About Computer Self-Efficacy and System Use

In general, perceived ability to engage in a behavior is directly related to whether an individual performs that behavior and for how long (Ajzen and Madden 1986). There are two ways to capture someone's belief about their potential to use a system. CB-CSE represents one approach. CB-CSE is defined as an individual's belief about their ability to use computer systems in general (Compeau and Higgins 1995, Marakas et al. 1998). Another approach is through CB about a specific computer system (CB-SCSE). CB-SCSE measures the degree to which someone believes they have the ability to use a particular system for a specific set of tasks (Marakas et al. 1998). There are many potential measures of CB-SCSE, some more or less context specific. In this paper we focus on the general measure of CB-CSE. CB-CSE has proven to be a predictor of duration of use across different systems (Agarwal et al. 2000; Compeau and Higgins 1995, Compeau et al. 1999). The same should hold true for deep structure use. Individuals who believe they have the ability to use computer systems in general should be more inclined to try the features of any particular system. Simply put, they are more likely to be confident in their ability to use new features related to any system. This, in turn, should promote their use of more features. Moreover, such general belief about their ability to use systems is based on trial-and-error experiences with past systems (Agarwal et al. 2000). Someone with a high level of belief in their ability to use any system is likely to have a propensity to explore and try new system features. Thus, we hypothesize:

Hypothesis 4 (H4). *CB-CSE will have a positive effect on* (a) *duration of use and* (b) *deep structure use.*

Control Belief About Advice from Co-Workers and System Use

Advice from co-workers, which is context specific and locally accessible, will help users use new systems (Boudreau and Robey 2005). Although formal information technology (IT) help desk support is important, it has some limitations. Formal IT help usually involves a procedure that can often delay resolution of the problem. Informal IT support, available through co-workers, can literally be next door, accessed instantly, and provided by someone who is familiar with the user (Bruque et al. 2008, Sykes et al. 2009). Also, IT personnel may be unfamiliar with the specific job or task domain of the help seeker, whereas informal support usually comes from co-workers who have acquired knowledge as a result of situated learning that is domain and context specific (Boudreau and Robey 2005, Davis et al. 2009, Morrison 2002, Santhanam et al. 2007).

Advice from co-workers will be associated with longer duration of use and deep structure use. Assistance from someone nearby who is knowledgeable about the user and task complements formal assistance as informal ties remove knowledge barriers at the moment of use, thus enabling longer periods of system use by employees (Gallivan et al. 2005, Sykes et al. 2009). In addition, informal advice from co-workers is a key source of initial awareness of advanced features and a type of post-training support on how to use those features (Jasperson et al. 2005, Santhanam et al. 2007). As a result, the number of features to which a user is exposed and the amount of help they have in using those features should be directly related to the number of co-workers who use those features and can provide assistance. Thus, we hypothesize:

Hypothesis 5 (H5). *CB-AC will have a positive effect on* (a) *duration of use and* (b) *deep structure use.*

Interaction Effects

We believe advice from co-workers is likely to complement the effects of CB-TC, CB-RA, and CB-CSE on system use. Situated learning is context specific and relative to the workplace environment in which the users are embedded. Situated learning through a community of practice during new system implementation is based on the system, set of tasks, organizational resources, and the user's ability to use the system. This means that system-related advice from co-workers is based on employees using the same system performing a similar set of tasks with access to similar organizational resources with users with similar system experiences. The advice is likely to be based on, and include help on, how to take full advantage of the system itself and the resources provided by the organization relative to the ability of the user. For example, there are often multiple ways to perform the same task using the same system. It is likely that a co-worker will provide advice on how to use the system in a way that corresponds to the user's skill level and in conjunction with resources already familiar to the user. Hence, advice from co-workers should bolster or complement the effects of CB-TC, CB-RA, and CB-CSE on system use.

Control Belief About Advice from Co-Workers, Control Belief About Technical Compatibility and System Use. The relationship between technical compatibility and duration of use and deep structure use should depend on advice from co-workers. In other words, the degree to which users understand how to take advantage of the system's technical compatibility will determine the degree to which these compatibilities will lead to more use. For example, users may know that the new system can be used in conjunction with Excel. Yet users may not understand how this is done or what features are needed (Jasperson et al. 2005, Santhanam et al. 2008). When this occurs, the system's compatibility with Excel will not translate to greater duration of use or deep structure use. In these situations, technical compatibility will have a very weak relationship with duration of use and deep structure use. Co-workers can show users how to use the new system in conjunction with existing systems (Constant et al. 1996). This, in turn, should allow users to use the new system for a greater range of tasks. When this occurs, CB-TC should have a stronger relationship with both types of system use as advice from co-workers increases. Advice from co-workers could also help users overcome the lack of technical compatibility. Co-workers often know workarounds that allow them and others to overcome the system's lack of technical compatibility. Thus, we hypothesize:

Hypothesis 6 (H6) *The effect of CB-TC on* (a) *duration of use and* (b) *deep structure use will be moderated by CB-AC, such that as CB-AC increases, the positive relationship between CB-TC and both types of system use will become stronger.*

Control Belief About Advice from Co-Workers, Control Belief About Resource Availability and System Use. The positive effect of resource availability on both types of system use should become stronger when it is accompanied by an increase in advice from co-workers. The likelihood of resource availability translating into longer system use depends on whether users effectively use those resources (Gallivan et al. 2005). Organizations may provide all of the needed resources to help users use the system but users may not understand how best to use those resources (Santhanam et al. 2008). For example, tutorials available to a user are more likely to translate into greater duration of use and deep structure use when the user has someone to guide them through the tutorials. Similarly, the same available assistance from a help desk will translate into greater duration of use and deep structure use when a colleague can identify the problem and provide the name of an IT specialist who is most likely to resolve the issue. Thus, we hypothesize:

Hypothesis 7 (H7). *The effect of CB-RA on* (a) *duration of use and* (b) *deep structure use will be moderated by CB-AC, such that as CB-AC increases, the positive relationship between CB-RA and both types of systems use will become stronger.*

Control Belief About Advice from Co-Workers, Control Belief About CSE and System Use. An individual's confidence in their general ability to use any system will have a stronger effect on both types of system use as advice from co-workers increases. Although users with high confidence in their ability to use computer systems in general are more inclined to use the particular system, like most new users, they are often not knowledgeable about the full range of tasks the system can support or how to use the specific system. As a result, they will often use the new system for a limited amount of time and use a very narrow set of features (Davis et al. 2009, Hu et al. 2003, Jasperson et al. 2005). Users with more advice from co-workers will be exposed to, and get help on how to use, a wider array of tasks that the system can be used to accomplish (Bruque et al. 2008). In turn, these same users will be more likely to expand their use of the system to encompass these wider arrays of tasks (Marakas et al. 1998). As users expand their use of the system they will use the system longer and are likely to use more features. As such, an individual's belief in their general ability to use a system should have a stronger relationship with duration of use and deep structure use as advice from co-workers increases. Thus, we hypothesize:

Hypothesis 8 (H8). *The effect of CB-CSE on* (a) *duration of use and* (b) *deep structure use will be moderated by CB-AC, such that as CB-AC increases, the positive effect of CB-CSE on both types of systems use will become stronger.*

Prior literature has suggested that CBs should moderate the effects of BI on actual behavior (for a discussion, see Fishbein and Ajzen 2010). This occurs when CBs represent actual behavioral controls, which can make an act easier or more difficult to perform. Consistent with prior (Ajzen 1991, Triandis 1979) and recent theory (Fishbein and Ajzen 2010), we examine whether CBs moderate the effect of BI on system use. However, we do not propose specific hypotheses; given that prior literature has discussed these relationships extensively, our goal is to examine whether these relationships hold in our context of system use (see Alvesson and Kärreman 2007 and Johns 2006). Examining these relationships can provide additional insights into the relationships between BI, CBs, and system use.

Method

Enterprise Information System

Data were collected on the implementation of a new enterprise-wide information system. The organization's objective was to implement an integrated content management system used to enable effective management of back-end processes (Guenther 2001). The new content management system helped employees manage all types of multimedia content by streamlining the process through well-defined workflows and templates. Employees (participants) generated the content that primarily consisted of communications with various suppliers and was made available to other employees in similar roles. Although jobs in the business unit were primarily designed to be autonomous, there were collective goals for the unit. System use was voluntary and employees could use alternative systems/methods to fulfill their duties. For the purpose of this study, we focus on system use by the focal business unit personnel in the fulfillment of their responsibilities.

Participants

The individual employee, a potential user of the system, was the unit of analysis in this study. The sampling frame for the study consisted of all employees, i.e., business unit supplier liaison specialists and supervisors, and an organization supplier liaison unit. The members of the business unit were knowledge workers. Employees were co-located and could use a mix of media to communicate with co-workers. There were 125 employees in the business unit. Of these, 112, including 22 women (25.3%), provided usable responses to both surveys, for a response rate of approximately 90%, which is above the generally recommended cutoff for social network studies (Sparrowe et al. 2001). The average age of participants was 38.9, with a standard deviation of 8.8. The average organizational tenure was just over 5 years. The demographic profile of the respondents matched the business unit's demographic profile.

Measurement

All constructs were operationalized in the context of an employee's use of an enterprise information system to perform work-related duties. Details about the scales used in this section are available in Online Appendix 2.

Behavioral Intention and Control Beliefs. Individuals' *BI* to use the system was measured using a three-item scale adapted from prior research (Venkatesh et al. 2003). *CB-TC, CB-RA,* and *CB-CSE* were adapted from previously validated scales of TFC, RFC, and CSE, respectively (Compeau and Higgins 1995, Taylor and Todd 1995, Venkatesh et al. 2003). Responses to items representing each control belief were collected using 7-point Likert-type scales, with 7 being the most positive response and 1 being the most negative response.

We used the number of *get-advice ties* to represent CB-AC. Because we are studying the effects of system-related advice received from co-workers, out-degree centrality is the appropriate conceptualization here. Out-degree centrality represents the number of co-workers who provide system-related advice to a user (adapted from Baldwin et al. 1997 and Sparrowe et al. 2001). Get-advice ties were determined using the give-advice matrices and responses about the people from whom they get advice and those to whom they give advice. To maximize the potential objective nature of the measure, we triangulated using get- and give-advice matrices and only considered a get-advice relationship to exist if it was reported by both parties. Data were collected using advice network matrices that listed all employees in the business unit. The advice network matrix was created by having each person in the business unit assess their frequency of seeking and giving advice. This resulted in a 112×1 matrix for each respondent i with respect to an alter j:

Get-advice$_{ij}$—Assessment of frequency of contacts made by employee i to get advice from employee j.

Get-advice$_{ij}$ was elicited through the following lead-in: "For the following people, indicate the extent to which you solicit advice for effective use of ⟨System X⟩ (e.g., system features, upcoming releases, demo dates, etc.). You should include all people that you interact with."

Similarly, we gathered give-advice data based on employee responses to which they give advice. Get-advice ties were conceptualized as out-degree centrality for each ego (employee), i.e., actors with a tie from ego in the *get-advice* network, overlaid with in-degree centrality to each ego (employee), i.e., with a tie to the ego in the *give-advice* network. As noted above, only reciprocal ties were counted and network centrality was computed by taking the number of ties incident on each ego.

System Use. We measured system use, i.e., *duration of use* and *deep structure use* using previously validated measures. Duration of system use was measured as the amount of time an employee engaged in hands-on interaction with the system. In keeping with earlier research (e.g., Venkatesh et al. 2003), duration of system use was assessed over a three-month period, where it was captured via computer logs based on the aggregate amount of active time that the employee spent using the system. The average time of use per week was then computed and used in our analyses. This measure excludes idle times of two minutes or more when employees may have been logged in but were not actively engaged in using the system. *Deep structure use* was measured using five items modeled after the items in Burton-Jones and Straub's (2006) work. Deep structure use was conceptualized as features used that relate to the core aspects of a particular task (Burton-Jones and Straub 2006). The five core tasks and the features were identified through a discussion with the system designers and employees who were part of the development team. Employees

Table 1. Descriptive Statistics and Correlations

		Mean	SD	1	2	3	4	5	6	7	8	9
Control variables												
1	*Performance expectancy*	3.82	1.03									
2	*Effort expectancy*	4.08	1.05	0.28***								
3	*Social influence*	4.22	1.19	0.12*	0.16**							
Predictors												
4	Behavioral intention	3.71	1.01	0.35***	0.25***	0.22***						
5	CB about technical compatibility	4.35	1.20	0.13*	0.23***	0.08	0.31***					
6	CB about resource availability	4.07	1.05	0.15*	0.24***	0.10	0.30***	0.25***				
7	CB about computer self-efficacy	5.10	1.35	0.07	0.26***	0.15*	0.21**	0.07	0.05			
8	CB about advice from co-workers	5.01	2.89	0.16**	0.13*	0.22***	0.25***	0.22**	0.17**	0.28***		
Dependent variables												
9	*Duration of use*	15.65	5.11	0.30***	0.22***	0.17**	0.44***	0.34***	0.46***	0.07	0.26***	
10	*Deep structure use*	3.69	1.71	0.28***	0.16**	0.19**	0.30***	0.31***	0.28***	0.21***	0.37***	0.14*

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

in this sample performed multiple tasks to accomplish their daily tasks. As a result, many feature-level items related to job-related tasks were captured. Supervisors were asked to identify the tasks to be accomplished using the target system. Five tasks, all related to the support of customer interactions, were identified as the primary tasks that the system was expected to support.

Control Variables. Drawing from the vast body of prior research on system use, we included variables that have been shown to influence system use as control variables (see Venkatesh et al. 2003). Specifically, performance expectancy (PE), effort expectancy (EE), and social influence (SI) were measured using items adapted from the unified theory of acceptance and use of technology (UTAUT; Venkatesh et al. 2003). All control variables were measured on a 7-point Likert scale. We also collected various demographic variables (age, gender, and organizational tenure) as control variables as they have been examined in prior studies; however, as they were all nonsignificant, we excluded them from our analysis.

Data Collection

Data were collected over a three-month period after implementation of a new enterprise information system in an externally focused business unit of a large multinational company. Two surveys were administered. In the first survey administered in the first month of implementation, each respondent was provided a roster with the names of all other individuals in the business unit and asked to report their contact with them in terms of getting and giving advice. This information was then used to compute get-advice network centrality. At the time of data entry, the names of respondents were re-coded into fictitious names to preserve participant confidentiality and privacy. In the same survey, participants also provided their responses to control variables and perceptions of CBs. Duration of use data were collected over the three-month period using system logs. The second survey was administered at the end of the third month and measured deep structure use.

Results

We first assessed the psychometric properties of the scales. All multi-item scales showed high reliability, with Cronbach alpha scores greater than 0.80. Internal consistency and discriminant validity were assessed using factor analysis with direct oblimin rotation to allow for correlated factors. All loadings were greater than 0.70 and cross-loadings were less than 0.35 (Fornell and Larcker 1981), thus suggesting internal consistency in scales and discriminant validity across scales. These results are shown in Online Appendix 3. Table 1 presents the descriptive statistics and correlations for the constructs in the model. We also note (from our regression analysis, discussed later) that none of the variance inflation factors (VIFs) were greater than 2, thus minimizing concerns of multicollinearity.

We chose hierarchical regression analysis in SPSS 22.0 to test our hypotheses. The results are shown in Table 2. Model 1 shows the effects of the control variables, i.e., PE, EE, and SI, on the dependent variables. Model 2 shows the direct effects of BI and the CBs (except CB-AC) on the dependent variables. Model 3 shows the direct effects of all CBs, including CB-AC. Model 4 includes the interactions between traditional CBs and CB-AC along with the control variables and main effects. All variables included in these interactions were mean-centered, as suggested by Aiken and West (1991), to reduce multicollinearity. The variance explained in each of the dependent variables significantly increased from Model 1 to 2 to 3. Model 4 includes the interaction effects associated with the CBs and CB-AC, which increased the variance explained from Model 3. Model 5 includes the interaction effects associated with BI-use and CBs, none of which were significant.

The first set of hypotheses examined the main effects. We found full support for H1 through H3 and H5. In other words, BI, CB-TC, CB-RA, and CB-AC had significant effects on both types of use but CB-CSE did not. The remaining hypotheses predicted interaction effects. We found partial support for H6. CB-AC did not moderate the effect of CB-TC on duration of use (H6A), but did moderate the effect of CB-TC on deep structure use (H6B). H7 was fully supported, as CB-AC moderated the effect of CB-RA on duration of use (H7A) and deep structure use (H7B). H8 was also fully supported, as CB-AC moderated the effect of CB-CSE on duration of use (H8A) and deep structure use (H8B). The main effects model for duration of use explained 33% of the variance, whereas the model with the interactions explained 46%. The main effects model accounted for 33% of the variance of deep structure use, whereas the model with the interaction effects explained 55%.

We plotted the interaction effects following the procedures given by Aiken and West (1991). Figures 2(a) through 2(g) show the various interaction plots in Online Appendix 4. All of the plots suggest a similar role for CB-AC across all traditional CBs, as hypothesized. The interaction plots suggest that CB-TC, CB-RA, and CB-CSE have less effect on any type of use when CB-AC are low, but their effect is amplified (stronger) when CB-AC are high. Specifically, from the plots, it can be seen that the slope of the effect of CB-TC, CB-RA, and CB-CSE is steeper when CB-AC is high; in fact, the slope of the low CB-AC line in all cases is not significantly different from zero.

The results of our hypothesis testing were robust to tests for common method bias. To some extent, these concerns are limited to the extent of temporal separation between measurement of the independent variables and dependent variables, which is further alleviated due to the archival measurement of duration of use. However, we ran the marker variable test using conscientiousness as the marker variable and found that the pattern of results, including interaction effects, was unaltered, although as expected the magnitude of some relationships reduced slightly. Only one significant relationship (BI and deep structure use) became nonsignificant.[1] Therefore, we conclude that the results reported here are likely robust to possible common method bias. Results are shown in Table 2.

Discussion

Our goal here was to incorporate advice from co-workers into the nomological network of system use in the form of a CB. Specifically, we extended the concept of CBs to include advice from co-workers, developed a research model to explain the effects of CB-AC on two conceptualizations of system use, and empirically tested that model in a field study. Results generally supported the proposed model and indicate that not only was CB-AC an important predictor of system use but also was vital to understanding the effects of other types of CBs on use.

Before we discuss the implications of our work, we explain some of our findings that ran counter to expectations. We begin with the findings related to CB-CSE that had no main effects on any type of system use but had strong interaction effects with CB-AC. The lack of a main effect could be due to the general, rather than specific, nature of our measure. We measured an individual's belief related to computer systems in general rather than to use of the specific system in this study. A specific measure of CB related to self-efficacy may have been a significant predictor of both types of system use even in the presence of the other CBs. All but two of the interactions involving CB-AC were significant. CB-AC did not moderate the effect of CB-TC on duration of use. For some users, CB-TC and CB-AC may have combined to lead to less use. In addition, the ability to fully leverage the technical compatibility of a new system might have actually allowed many users to accomplish their work with less system use. This would explain the non-significant moderation effect between CB-TC and CB-AC on duration of use.

Contributions

Our work contributes to the literature in several ways. First, we demonstrate the importance of including CB-AC as a representation of situated and improvised learning in the nomological network of system use. Although CB-TC and CB-RA are good predictors of use, they alone do not entirely reflect the external conditions that facilitate use. Resource availability simply does not fully represent the help available to support users. Although some studies have shown the importance of situated and improvised learning (see Boudreau and Robey 2005) to promote system use and overcome inertia, to our knowledge they have not recognized that situated and improvised learning represent a type of CB or how they work in tandem with other environmental conditions, here, CBs. Our work suggests that system-related advice from co-workers is important to promoting system use. Table 2 shows that CB-AC was a significant predictor of both types of system use beyond other factors.

Second, our results demonstrate the importance of CB-AC as a moderator of the other types of CBs. By studying various possible moderating effects, we contribute to the system use literature in two ways. First, our results show how CB-AC alters the effect of other CBs on system use. Based on our results, it appears that CB-AC was important to understanding the effectiveness of traditional CBs. Specifically, having CB-AC appears to be an important factor for achieving higher

Table 2. Regression Results

	Duration of use					Deep structure use				
Model	1	2	3	4	5	1	2	3	4	5
R^2	0.10	0.26	0.33	0.44	0.46	0.08	0.23	0.33	0.52	0.55
ΔR^2		0.16^{***}	0.07^{**}	0.11^{***}	0.02^{*}		0.15^{***}	0.10^{***}	0.19^{***}	0.03^{*}
Control variables										
Performance expectancy	0.20^{**} (0.03)	0.12^{*} (0.03)	0.04 (0.08)	0.01 (0.05)	0.01 (0.08)	0.17^{**} (0.02)	0.11^{*} (0.03)	0.05 (0.08)	0.04 (0.07)	0.03 (0.06)
Effort expectancy	0.17^{**} (0.04)	0.13^{*} (0.02)	0.04 (0.08)	0.01 (0.05)	0.00 (0.07)	0.14^{*} (0.01)	0.08 (0.07)	0.05 (0.09)	0.04 (0.09)	0.01 (0.04)
Social influence	0.15^{*} (0.03)	0.09 (0.07)	0.05 (0.10)	0.03 (0.08)	0.02 (0.08)	0.16^{**} (0.01)	0.10 (0.08)	0.07 (0.11)	0.03 (0.10)	0.02 (0.03)
Main effects										
Behavioral intention (BI)		0.32^{***} (0.02)	0.29^{***} (0.02)	0.24^{***} (0.02)	0.19^{**} (0.02)		0.21^{***} (0.02)	0.19^{**} (0.01)	0.12^{*} (0.01)	0.08 (0.08)
CB about tech compatibility (CB-TC)		0.22^{***} (0.02)	0.19^{**} (0.04)	0.14^{*} (0.04)	0.12^{*} (0.02)		0.22^{***} (0.02)	0.21^{***} (0.02)	0.12^{*} (0.01)	0.10 (0.08)
CB about resource availability (CB-RA)		0.24^{***} (0.04)	0.21^{***} (0.03)	0.17^{**} (0.03)	0.13^{*} (0.03)		0.24^{***} (0.01)	0.21^{***} (0.02)	0.14^{*} (0.02)	0.11^{*} (0.02)
CB about computer self-efficacy (CB-CSE)		0.07 (0.09)	0.04 (0.08)	0.01 (0.08)	0.01 (0.07)		0.08 (0.09)	0.05 (0.07)	0.07 (0.06)	0.03 (0.08)
CB about advice from co-workers (CB-AC)			0.21^{***} (0.02)	0.13^{*} (0.02)	0.11^{*} (0.01)			0.28^{***} (0.02)	0.14^{*} (0.01)	0.11^{*} (0.01)
Interaction effects of CBs with CB-AC										
CB-TC × CB-AC				0.05 (0.10)	0.02 (0.05)				0.23^{***} (0.02)	0.21^{***} (0.03)
CB-RA × CB-AC				0.13^{*} (0.02)	0.12^{*} (0.02)				0.22^{***} (0.03)	0.19^{**} (0.02)
CB-CSE × CB-AC				0.14^{*} (0.02)	0.12^{*} (0.01)				0.13^{*} (0.03)	0.12^{*} (0.01)
Interaction effects of BI with CBs										
BI × CB-TC					0.04 (0.08)					0.04 (0.07)
BI × CB-RA					0.02 (0.09)					0.01 (0.05)
BI × CB-CSE					0.04 (0.10)					0.07 (0.07)
BI × CB-AC					0.02 (0.08)					0.08 (0.10)

$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

levels of use in that it enhances the effects of other CBs that facilitate use. Second, we explored the moderating effects between CB-AC and BI on both types of system use. Both interactions were nonsignificant. However, we should consider this in light of two plausible explanations: CBs may not have been an accurate representation of actual controls, or the effects of CBs relative to BI could already have been taken into account during the formation of BI. Nonetheless, our results facilitate better understanding of the effects of CBs and BI on system use.

Finally, we contribute to the system use literature by demonstrating the importance of CB-AC to predicting a rich conceptualization of system use. This coupled with the fact that the inclusion of the interaction effects with CB-AC explained 11% and 19% of the additional variance in duration of use and deep structure use, respectively, provides further evidence of the importance of CB-AC. We believe that one reason CB-AC is better at predicting a rich conceptualization of system use is that such a conceptualization triggers the need for context-specific advice. Duration of use, which does not take into account how the system is being used or for what purpose, may not trigger the same need for context-specific advice. In fact, duration of use was not highly correlated with deep structure use. This is important because many IS studies use some variant of duration as their measure of system use (e.g., Venkatesh et al. 2003, 2008). Note that this could also be due, in part, to the different approaches to measuring duration of use (i.e., actual systems logs) versus deep structure use (survey items). Notwithstanding, our results seem to lend further empirical support to the argument made by Burton-Jones and Straub (2006) that there are valid and important reasons for carefully selecting an appropriate measure of use.

Limitations

There are a few limitations of our study that must be acknowledged. First, this study did not examine the type of advice being requested. It is quite possible that people only go through informal channels for a specific type of advice. Second, for this study, CB-AC was based on the get-advice network in the focal business unit. A measure of CB-AC that includes advice ties beyond these boundaries could yield different outcomes. Another limitation is the homogeneity in the setting and sample. All users have similar jobs involving related tasks, received the same training, and have used the same system over the same time period. Finally, although the items used to measure CB-TC and CB-RA were taken directly from Taylor and Todd (1995), several of the items for each construct were too similar. (Netemeyer et al. 2003, p. 105) would call this a "useless redundancy." Future research is needed to develop better scales for measuring both CB-TC and CB-RA.

Theoretical Implications and Directions for Future Research

This work has several implications for theory and future research. First, this work and prior research has highlighted the importance of situated and improvised learning (see Boudreau and Robey 2005). IS researchers have long recognized the importance of situated and improvisational learning derived from communities of practice but have rarely considered them in the context of CBs. When we consider that CB-AC not only predicted system use but also moderated the relationships of other types of CBs to system use, it underscores the importance for future research to incorporate situated and improvised learning. If we accept the view that organizations are "social systems of collective action that structure and regulate the actions and cognitions of organizational participants through rules, resources, and social relations" (Oscasio 2000, p. 42), the social network perspective used in this work presents new opportunities for studying the impacts of situated and improvised learning to create more comprehensive and better models of technology acceptance and use. Our findings notwithstanding, as a research community, we still know little about how to facilitate situated and improvised learning among users in organizations. Future research should be directed at understanding how to create, sustain, and exploit the advice from these communities of practice.

Second, we have only used a small subset of available CBs mentioned by Ajzen (1985, 2005). Ajzen (1985, 2005) mentioned various internal factors such as individual differences in locus of control, emotions, compulsions, and willpower, and various external factors, such as opportunity and dependence on others. Future research is needed not only to explore the effects of these other CBs but also to develop measures of them. Finally, we have built a paradigm of technology acceptance research designed to predict lean conceptualizations of use. However, richer conceptualizations of system use appear to be more closely related to the elusive performance benefits that we seek from technology implementations (Burton-Jones and Straub 2006). Judging by the variance explained in the prediction of deep structure use by the traditional variables, there is a need to find alternative theoretical perspectives, concepts, and resultant constructs.

Practical Implications

This study has several implications for practitioners. Our results shed light on the role of co-worker assistance in fostering richer, more performance-oriented system use. Therefore, managers must find practices that encourage system-related exchanges among co-workers in organizations. One approach is to create a buddy system where employees with low system proficiency are assigned a co-worker (i.e., buddy) who is very knowledgeable about the system. This buddy should be someone with a job description similar to the employee with limited system knowledge. This buddy can be the first contact for help when the employee needs assistance. Such an approach would more proactively manage the network impacts and ensure greater and more uniform help that will not leave behind isolates in the network.

Another approach is to capture advice from coworkers, exchanged between few individuals, and disseminate it to a wider audience. Managers could encourage and perhaps reward users for leading training sessions where tips of the week are introduced. These tips could be context-specific advice on how to leverage the system to accomplish work tasks. This advice could come in the form of video clips provided by users to supplement online support forums. Managers can also encourage users to create online tutorials showing how to use a specific system feature. These tutorials could also be uploaded to online support forums. By taking an active role, managers can help to ensure that the knowledge derived from these communities of practice is available to more users.

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Endnote

[1] Given the potential concerns with the marker variable test (e.g., Sharma et al. 2009), we also used other approaches, such as the Harman one factor test, and found that common method bias was not a problem in our data set.

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